FETC SUCCESS
U.S. Department of Energy
Federal Energy Technology Center

CLEAN AFFORDABLE POWER

- [x] fossil energy
- [ ] environmental
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Computational Fluid Dynamic (CFD) Combustion Codes for In-Furnace NO_x Control

States Impacted:
Alabama, California, Delaware, Ohio, Illinois, Indiana, Kansas, Kentucky, Louisiana, Maryland, Minnesota, Missouri, New Jersey, New York, North Dakota, Pennsylvania, South Carolina, and Tennessee.

Benefit Areas:
Environment, Technology Leadership

Participants:
Reaction Engineering International (REI), University of Utah, Brown University, and DB Riley, Inc.

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Description

In-furnace NO_x control techniques, namely low NO_x burners and coal reburning, are the most cost-effective methods for reducing NO_x emissions, but have a negative impact on carbon utilization by increasing unburned carbon levels in coal ash. In-furnace NO_x control also causes higher waterwall wastage with corrosion resulting from the reducing atmosphere.

Model development has generated comprehensive fluid dynamic combustion codes, including NO_x formation mechanisms, unburned carbon predictions, a real-time corrosion monitoring system, detailed selective non-catalytic reduction (SNCR) chemistry, and air toxics predictions.

Versions of CFD codes are being applied to over 30 utility boilers with 21 gigawatt capacity in the U.S., as well as the Ukraine, Italy, Russia, Germany, and Taiwan. These utilities are able to improve fuel injector designs and firing systems for optimum operating conditions.

REI's approach to solving utility's requests involve not only dynamic simulation of the boiler in question, but also utilizing diagnostic tools and in-furnace measurements to support the plant modifications resulted from the boiler simulations.

Goals

The goal of this project is to maximize NO_x reduction, while minimizing unburned carbon in ash in combustion systems using low-NO_x burners and coal reburning. Work scope expanded to include the development of simulation products that enable utilities to decide on the most cost-effective NO_x control technology.

Tangible Benefits

National: Over the previous four years, REI has serviced over 30 utility companies with 21 gigawatt of boiler capacity, resulting in significant cost savings to the utility industry.

Regional/Local: In Northern Indiana Public Service Co's (NIPSCO's) Michigan City Unit 12, a cyclone fired boiler, NO_x emissions were reduced by 50% by optimizing the size, number and location of overfire air (OFA) ports as well as by controlling the exit velocity and stoichiometry. This new configuration can reduce NO_x, as well as improve the carbon monoxide furnace imbalance significantly. (From an article published in Power Engineering, January 1999).